Psychological Features of People Willing to Travel to Space

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Tiivistelmä

Ihmiset tulevat yrittämään avaruuden valloittamista lähitulevaisuudessa ja siihen liittyviä teknologisia ongelmia pyritään aktiivisesti ratkaisemaan. Vapaaehtoisen avaruusmatkustukseen ja avaruuden asuttamiseen liittyvät psykologiset kysymykset ovat kuitenkin jääneet huomiotta tieteellisessä tutkimuksessa.

Psykologisten ominaisuuksien, kuten persoonallisuuden, tiedetään vaikuttavan moninaisesti ihmisten toimintakykyyn ja käyttäytymiseen erilaisissa ympäristöissä.

Tämä pro gradu-työ tutkii ennustavatko psykologiset ominaisuudet (Big-5 persoonallisuus, Schwartzin arvot, empatisoiva-systematisoiva kognitiivinen tyyli, dark triad-piirteet) ihmisten halukkuutta matkustaa avaruuteen ja vieraille taivaankappaleille. Työn keskeinen löydös on se, että mainituista ominaisuuksista avaruuteen vapaaehtoisesti haluavien keskeinen psykologinen ominaisuus on vahvasti systematisoiva kognitiivinen tyyli.

Tämän ominaisuuden taustalla on myös muista psykologisia ominaisuuksia, joita työssä käsitellään tarkemmin. Taustalla oleva rakenne on myös psykometrisesti kiinnostava, sillä se kytkee tutkitut erilaiset mittarit joiltakin osilta keskinäiseen riippuvuusrakenteeseen.

Vapaaehtoisen avaruusmatkustuksen psykologiaa ei ole tutkittu aiemmin. Työssä pohditaan lukuisia kiinnostavia uusia suuntia, joita tämä aiemmin tutkimaton aihe tarjoaa.

Avainsanat

Big-5, Persoonallisuus, Schwartin arvot, Arvot, EQSQ, Kognitiivinen tyyli, Dark triad, Avaruusmatkustus, Causal Mediation Analysis

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Abstract

Mankind is making serious efforts towards eventually conquering other heavenly bodies and start habiting space. The technical problems relating to travel and habitation are being solved. Nevertheless, psychological questions relating to voluntary space travel and habiting space have not been researched.

Psychological features, like personality, are known to affect general operational effectivity and behavior in different environments.

This thesis analyses if psychological features (Big-5 personality, Schwartz values, empathizing-systemizing cognitive style, dark triad) predict willingness to travel to space or to celestial bodies. The key fining is that, out of the mentioned features, systemizing cognitive style predicts the willingness to go to space.

Other psychological features are also linked to systemizing cognitive style and these features are discussed in more detail. The underlying structure is also psychometrically interesting as it ties in some of the researched measures in causal structure.

Vapaaehtoisen avaruusmatkustuksen psykologiaa ei ole tutkittu aiemmin. Työssä pohditaan lukuisia kiinnostavia uusia suuntia, joita tämä aiemmin tutkimaton aihe tarjoaa.

The psychology of voluntary space travel has not been previously researched. The thesis discusses new interesting potential new research directions related to this topic.

Keywords

Big-5, Personality, Schwarz values, Values, EQSQ, Cognitive style, Dark triad, Space travel, Causal Mediation Analysis

Where deposited

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Introduction

Mankind is making serious efforts towards eventually conquering other heavenly bodies and start habiting space. The technical problems relating to travel and habitation are being solved (Musk, 2017; Buchanan, 2017). Elon Musk (2017) titled his paper on the topic "Making Humans a Multi-Planetary Species." Other ways people are planning to live in space include asteroid mining and orbital manufacturing. (Pooler, 2017; Cookson, 2017) In 2016, private investment in space exploration reached $ 3.1 billion. (Cookson, 2017) A company plans on launching near earth orbit hotel by 2021. (Bloomberg, 2018) On August 13, 2018, president Trump signed a law establishing United States Space Command, which planned to evolve separate sixth branch of United States Armed Forces colloquial known as Space Force. (John S. McCain National Defense Authorization Act for Fiscal Year 2019) The recent observation of first interstellar object, 'Oumuamua (1I/2017 U1), in Solar System has captured the imagination of research community especially after recent speculation that it is a lightsail of artificial origin. (Meech, *et al.*, 2017; Belton, *et al.*, 2018; Micheli, *et al.*, 2018; Bialy & Loeb, 2018) Such observations and speculations will push the interest in space exploration still further. In short, humans are making serious effort to conquer space in near future.

Conquering space will not only mean solving technical problems but also problems relating to the fact that it is humans that are doing the conquering. This means that forming functional operations and colonies should be studied and planned from the perspective of humanities, which brings us to psychology.

Personal psychological features predict and affect the effectiveness of humans in adverse situations. The seminal paper on the topic of human psychology and operational effectivity by Shils and Janowitz (1948) studied how and why German Wehrmacht managed to hold their fighting spirits in

the Second World War when they were “distinctly outnumbered […], inferior in equipment, […] broken into unconnected segments, and the remnants were overrun.” They attributed this to fulfilment of primary emotional needs by the peer group. In other words, the effectiveness was result of correctly formed social order that leveraged human psychology. More recent studies have looked into such topics as the operational effectivity of astronauts, people living in Antarctica and operating naval vessels. In these studies, the impact of the personality has been identified as an important contributing factor. (Palinkas et al., 2000; Grant et al., 2007; Rose et al., 1994; Manzey, Lorenz & Poljakov, 1998; O'Daniel, 2012; Palinkas et al., 2010)

Any future space colonization efforts and even smaller scale commercial operations ignore human psychology at their own peril: strife, conflict and societal dysfunction could very well lead to extinction of the whole colony or operation, costing countless lives, an immeasurable amount of effort and delaying the operation by decades. Understanding these problems and preparing for them requires psychological understanding of the colonies and operations, their habitants and psychosocially relevant factors of the environment.

To the best knowledge of the author, the topic of psychology of space travel and space colonization is previously unresearched. There do not exist psychological studies researching what would make a colony socially viable to survive extended periods of time in previously uninhabited environments, capable to procreate a next generation of humans, and finally maintain and propagate its functional culture to this next generation. These questions have been previously only been speculated on in the realm of science fiction. Some classical works include The Mars Project by von Braun (1991) of the Apollo Project fame, The Martian Way by Asimov (1985), The Mars Trilogy by Robinson (1992; 1993; 1996; 1999) and The Sky So Big and Black by Barnes (2002). Humans living in Mars has also captured the imagination of movie goers with titles like Total Recall. (Feitshans, Shusett, & Verhoeven, 1990)

As addressing the general questions about psychological needs for sustained human culture in other planets would be way too ambitious, this thesis tries to lay some ground work. It will try to understand what kind of people are going to form these colonies and work in these operations. I will analyze psychological features that predict willingness to travel to space.

Psychological Features Relevant to This Thesis

Personality

Here we use the term "personality" to refer dispositional traits, general tendencies and idiosyncrasies of person. (McAdams, 1995) Such personality can be measured. The Big Five is one of the most widely used such a measure of personality, and it can be considered a consensus model on the general taxonomy of personality traits. (John, Naumann, & Soto, 2008; DeYoung & Gray, 2009; Digman, 1990; Goldberg, 1993; DeYoung, Quilty, & Peterson, 2007; Thompson, 2008) It was formulated in late 1980s and originated from factor analysis of adjectives used for describing people. (John, Naumann, & Soto, 2008; DeYoung & Gray, 2009; Goldberg, 1993; John, Naumann, & Soto, 2008) This thesis uses a Big Five -model where each of the five dimensions is divided to two facets. (DeYoung, Quilty, & Peterson, 2007) The Big Five dimensions (and their facets) are Extraversion (Enthusiasm and Assertiveness), Agreeableness (Compassion and Politeness), Neuroticism (Volatility and Withdrawal), Consciousness (Industriousness and Orderliness), and Openness to Experience (Openness and Intellect). (DeYoung, Quilty, & Peterson, 2007)

Studies have identified psychological features and especially personality as a contributing or important factor for the general operational effectivity. Low neuroticism, low extraversion and conscientiousness along with military service and low desire for affection were associated with better performance in men who spent a winter at Antarctica. (Palinkas et al., 2000) When selection of Antarctic personnel was analyzed, personnel who adapted "exceptionally well" were high on

openness to experience. (Grant et al., 2007) In 65 NASA astronauts, low openness and high agreeableness were associated with better performance. (Rose et al., 1994) When a Russian astronaut was monitored repeatedly on a 438-day mission, the first three weeks on the mission and the first two weeks back on Earth were associated with clear impairments of mood. (Manzey, Lorenz & Poljakov, 1998) Naval officers consider personality as a key contributor to positive performance and especially so when the operational tempo is high, e.g. in combat situation. (O'Daniel, 2012) The best psychological predictors for overall performance in confined environments were low neuroticism, low extroversion, high achievement value, being motivated and enjoyment and awe of the environment. (Palinkas et al., 2010)

These results are only partially applicable to situation presented in current study. First, in most cases, the people participating in these settings (astronauts, soldiers) have gone through a vetting process. Second, these operations are not independent of surrounding culture. Third, these are only time-restricted operations. To drive the point further, living in a Martian colony adds a new level of complexity when compared above mentioned operations: the normal social life of humans. A simple social conflict, such as infidelity and divorce, could very well be so important an event that it renders any sensible co-operation between participants useless. Worse still, leaving is not an option. The impact of such conflict and resulting decrease in working effectivity and communications can very well lead to extinction level technical errors. Divorce is linked to personality features agreeableness and neuroticism. (Ozer & Benet-Martinez, 2006) Research on personality and infidelity is conflicting but most recent research shows that high neuroticism and low religiosity predicts infidelity. (Schmitt, 2004; Barta & Kiene, 2005; Whisman et al., 2007) The examples of infidelity and divorce are only one of many potential sources of social discord. Research on various mechanisms on social structures is out of the scope of this thesis but it is clear that the personality traits discussed also relate to the likelihood of social conflict.

There are many other examples of areas where psychological features are important include the following examples. Volunteerism is linked to extraversion and agreeableness. (Carlo et al. 2005) High conscientiousness and low extraversion scores predicted high leadership effectiveness in military. (McCormack & Mellor, 2002) In military group setting high consciousness, high agreeableness and low variance in agreeableness predicted group performance. (Halfhill *et al.* 2005) In military aviation, the positive training outcomes were predicted by low neuroticism and high extroversion. (Campbell, Castaneda, & Pulos, 2009)

Personality of those willing to participate to voluntary space travel has not been previously studied. Never the less, some topics previously research topics could be closely related. First, we must consider astronauts. In NASA's final stage astronaut applicants, no personality differences were found between those who were chosen and those who were not. (Musson, Sandal & Helmreich, 2004) Nevertheless, the final stage applicants had lower neuroticism and higher extraversion, consciousness and agreeableness compared to general population. (Musson, Sandal & Helmreich, 2004; Musson & Keeton, 2011) The difference between astronaut candidates and the general population was substantial. European Space Agency astronaut candidates had lower neuroticism and higher openness to new experience, agreeableness, and consciousness even when compared to United States air force pilot students. (Maschke, Oubaid & Pecena, 2011) At least some of the lower neuroticism was due to selection in the process, as neuroticism was significantly higher within the failed astronaut applicants compared to those who make it. (Mittelstädt *et al.*, 2016)

Also, other occupational choices might also relate to willingness to travel to space. Low agreeableness, low neurotic and low openness to experience predicted willingness to join military. (Jackson, *et al.*, 2012) Military aviation pilots were marked by high extroversion and low agreeableness for both male and female pilots, while female pilots also had higher openness to new experience. (Callister *et al.*, 1999)

The willingness of people to travel space might be related to general willingness to make other life altering changes in their life. High openness to experience and low agreeableness predicted migration between states within United States. (Jokela, 2009) Divorce is also an event where an individual takes a drastic step to change their life, and it is predicted by low agreeableness and high neuroticism. (Ozer & Benet-Martinez, 2006) Nevertheless, it must be pointed out that both of these traits predicted unhappiness within a relationship, which in turn may lead to divorce.

As an interesting side note (not specifically relating to this study), one interesting line of thought is whether the act of traveling to space will itself change the personality of those who travel. Military service is known to alter the personality by lowering agreeableness. (Jackson, et al., 2012) Whether such a change in personality traits is something that would also apply to space travel remains unknown, as the specific reasons behind the decrease in agreeableness are not known.

Values

Values purport to describe underlying motivations of humans and their research has a long history. (Schwartz, 1992; Spranger & Pigors, 1928; Rokeach, 1968) One well-research value model is the Schwartz value model from 1990, which is the basis for the value model used in this thesis. (Schwartz, 1992) It defines ten values that derive their theoretical justification to biology: Self-Direction, Stimulation, Hedonism, Achievement, Power, Security, Conformity, Tradition, Benevolence and Universalism. (Schwartz, 1992; Schwartz, 2012) Specifically, this thesis uses refined Schwarz value model from 2012 that consists of 12 main values (it added Face and Humility) and 19 facets that form them: Self-Direction, Power, Security, Conformity and Benevolence each have two facets, and Universalism has three facets. (Schwartz, et al., 2012)

Relating to the research question, the organizational efficiency is affected by organizational culture, and this relationship is moderated by the top manager’s self-direction and stimulation values. (Aktaş, Çiçek & Kıyak, 2011)

Cognitive Styles

One way of dividing people's cognitive style is the tendency to understand world by empathizing or by systemizing. (Baron-Cohen, 2002) Empathizing refers to persons capabilities and tendencies to use empathy-driven mode of cognition, while systemizing is system-centric mode of cognition. (Baron-Cohen, 2002; Baron-Cohen & Wheelwright, 2004; Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004; Muncer & Ling, 2006; Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003; Ling, Burton, Salt, & Muncer, 2009)

In empathy-driven mode of cognition the events in the world are thought and predicted in terms of the mental states and affective responses of others. It related to concepts "theory of mind", "empathy" and "sympathy." (Baron-Cohen, 2002) People good at empathizing are good predicting situations determined by social interactions. (Baron-Cohen, 2002) Empathizing can be divided to three different facets: Cognitive Empathy, Social Skills and Emotional Reactivity. (Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004; Muncer & Ling, 2006)

Systemizing can be considered to be competing strategy to empathy-centric cognition, where surrounding world is understood as 'system' consisting inputs, outputs, possible manipulations or operations and rules that govern state transitions. (Baron-Cohen, 2002; Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003) There are tentative studies purporting that systemizing can be divided in four facets: "An interest or ability with DIY", "interest or ability with technical information", "interest or ability with the structure of things" and "interest or ability with spatial arrangements." (Ling, Burton, Salt, & Muncer, 2009)

Cognitive style is relevant to potential space travel in multiple ways. There are gender differences in cognitive style: At a population level, women are stronger on empathizing while men stronger on systemizing. (Baron-Cohen, et al., 2003; Baron-Cohen & Wheelwright, 2004) Cognitive style predicts vocational choices. For example, systemizing cognitive style is a good predictor (in fact,

better than sex) for predicting entry into physical sciences compared to humanities. (Billington, Baron-Cohen & Wheelwright, 2007) On the other hand, ability to empathize with others is a strong predictor for entry to nursing profession. (Penprase, 2013) Interestingly, cognitive style is not only heritable but also seems to affect offspring sex ratio: People with systemizing cognitive style have more sons, while those high on empathizing have more daughters. (Kanazawa & Vandermassen, 2005) This might have effects in potential space environments where people procreate. Finally, cognitive style is linked to prenatal testosterone exposure. (Auyeung, *et al.*, 2009) This is also predictor for various relevant psychological features such as risk taking and career choices. (Sapienza, Zingales & Maestripieri, 2009) Some of the effects of prenatal testosterone effects, but not all, are mediated by cognitive style. (Manning, *et al.*, 2010)

Detrimental Personality Features

The most typical "offensive yet non-pathological" personality traits are clustered together in one main model: Dark Triad. (Paulhus & Williams, 2002; Jones & Paulhus, 2014; Furnham, Richards, & Paulhus, 2013; Jones & Figueredo, 2013) It consists of Machiavellianism, narcissism (sub-clinical) and psychopathy (sub-clinical). Even as the three facets have a high degree of correlation with one another, they can be still considered separate. (Jones & Paulhus, 2014)

High scores in Dark Triad traits are linked to low scores in Big Five Agreeableness and Consciousness. (Furnham, Richards, & Paulhus, 2013) All three traits share a callous and manipulative core. (Jones & Figueredo, 2013)

High scores in the Dark Triad predict counter-productive behavior in work settings. (Furnham, Richards, & Paulhus, 2013) Nevertheless, Dark Triad traits can help people to acquire positions of leadership, while unfortunately also predicting bad performance as a leader. (Furnham, Richards, & Paulhus, 2013) The trait of Machiavellism is linked to leadership even by its name: it is named after

the Italian statesman who described the Machiavellian approach to ruling other people. (Machiavelli & Kallio, 1997)

Personality and detrimental personality features have also been shown to affect the way people interact in work environments. (McCrae & Costa, 1989; Louie, Kurtz & Markey, 2016; Dowgwillo & Pincus, 2017)

Research question

This study researches the relationship between psychological features and willing to travel to space.

The found personality features are compared to previously identified areas of life in search of field life where the research results could be used to generalize the predictions about those willing to travel to space. These fields of life include astronauts, those who join military, pilots, those migrating and those divorcing.

Methods

Participants

The relationship between personality traits and willingness to travel to space is done with a web questionnaire, available at https://togowhowants.net. The data was gathered between 4th January 2018, and 18th February 2018. The questionnaire was advertised in various online forums but the main thrust for answers came from an article at Slashdot (please see Appendix B for more information). The participants were offered two version of the questionnaire: short and long. They are explained in more detail below. In the end there was 185 valid answers to the long questionnaire and 421 valid answers to short questionnaire (including the answers to long questionnaire). The Table 1 shows the general statistics of participants. I should highlight the skewed male-female-ratio that is approximately 9:1. The main source for the answers was from Slashdot, a site that is known to have male dominated readership (Solarwinds Pingdom, 2012).

Table 1: General statistics of subjects

	Long questionnaire	Both questionnaires
Total	185	421
Sex		
Male	167 (90%)	383 (91%)
Female	18 (10%)	38 (9%)
Age		
14 or younger	1 (1%)	5 (1%)
15-19	4 (2%)	15 (4%)
20-24	21 (11%)	37 (9%)
25-34	47 (25%)	94 (22%)
35-44	57 (31%)	138 (33%)
45-54	34 (18%)	80 (19%)
55 or older	21 (11%)	52 (12%)
Country		
United States	86 (46%)	197 (47%)
Canada	29 (16%)	49 (12%)
Finland	18 (10%)	33 (8%)
United Kingdom	10 (5%)	23 (5%)
Australia	7 (4%)	15 (4%)
Netherlands	4 (2%)	11 (3%)
(Other)	31 (17%)	93 (22%)

Questionnaire

The questionnaire contains two options: Short Questionnaire and Long Questionnaire. This design was made with hopes that some people are not (at least initially) willing to spent over 30 minutes to answer questions. After finishing the long questionnaire, subjects are encouraged to take the long questionnaire.

Considerable effort was put in the aesthetics of the questionnaire as it is known to be an important factor increasing both data quality and probability that a subject will, in fact, finish questionnaire. (Mahon-Haft, & Dillman, 2010) Close attention was paid so that the questionnaire is at least as usable with a mobile device as it is with a typical desktop computer as we expected mobile device usage to be prevalent.

The questionnaire contains questions measuring ten aspects of Big Five, Dark Triad, Schwartz values, Emphasizing-Systemizing cognitive style and willingness to travel to space. Each of these five categories are explained in more detail below. In addition, we gather the following general information: age, sex and country of residence. Finally, the questionnaire has separate questions for measuring willingness to go to space.

Data

In the end there was 447 answers. Out of those answers 185 answers are to the long questionnaire and 262 to the short questionnaire. As the questionnaire site encouraged users that had filled the short questionnaire, to further fill the long questionnaire, we expected a few duplicates. We identified 26 such answers upon which the corresponding short questionnaire response was removed from the dataset leaving us with 185 answers to long questionnaire, 236 answers to short questionnaire and 421 answers in total.

Specific short questionnaire questions were selected without consideration for representativeness of the questions. After the data was gathered, it turned out that the selected questions in short questionnaire were not representative. For multiple psychological features the selected questions had poor internal consistency and the mean of the answers of the short questionnaire and long questionnaire did not correlate strongly enough. Therefore, the shot questionnaire data was dropped and only the answers to long questionnaire were used for psychological features. Willingness to go questions where identical in both questionnaires, so the short questionnaire data was used in that case.

Measuring Willingness to Go to Space and Mars

To measure persons willingness to travel to space, we derive a set of question from different relevant scenarios that purports to describe possible, realistic ways a person might have an option to travel to space. The four scenarios are

- persons willingness to travel to holiday to Earth's orbit;
- persons willingness to go to work on to asteroid mining operation in Earth's near space;
- persons willingness to permanently move to settlement in Mars; and
- persons willingness to participate to a self-sacrificing mission to Mars with a purpose to make future colonization possible.

As the questions relate to major life decisions, the questions should prime subjects to think about them in a fashion that makes questions as personal and as realistic as possible. Therefore, questions are scenarios, or stories, instead of just a blunt question "would you be willing to travel to Mars?" to elicit more honest and realistic answers. The scenarios were made as concrete as possible contained different features that a typical person might consider reasons not to go. After providing subjects with the scenarios they were asked to make a go/no-go -decision with a *maybe*-option. If the subject selects *maybe*, he or she is presented a continuation question where he or she can indicate the features that should change to make he or her answer in affirmative. In the end, each subject has answered the four main questions with a No-Maybe-Yes-scale and all the continuation questions in No-Yes-scale. The four scenarios and the continuation questions are described in more detail in Appendix A: .

We convert answers from subject i to scenario s to single metric $\widehat{w}_{i,s}$ describing the level of willingness to participate in said scenario:

$$\widehat{w}_{i,s} = \begin{cases} 0, \text{when main answer is } No \\ \dfrac{count(\text{maybe options that are } Acceptable) + 1}{count(\text{all maybe options}) + 2}, \text{when main answer is } Maybe \\ 1, \text{when main answer is } Yes \end{cases}$$

From $\widehat{w}_{i,s}$ values we create a single measure w_i, what we could call, willingness to go. The relationship between w and $\widehat{w}_s$ is created by building a single factor model out of $\widehat{w}_s$ and w interpreted to be the single factor. Factor loading ranged from 0.56 to 0.75.

Single factor model from the data has RMSEA index is 0.06 and Tucker Lewis index is 0.978. This indicated that we have justification of assuming that the data has a single underlying factor. As the single factor can be interpreted to describe the underlying individual tendency willingness to go to space, we conclude that there is a single "willingness to go" -variable. The willingness to go -variable explains well the individual answers to different scenarios as the multiple $R^2 = 0.78$ in the aforementioned single factor model.

Measuring Personality Features

Table 2: Sources and number of questions in both short and long questionnaire

Section	# facets	# questions in short questionnaire (per facet)	# questions in long questionnaire (per facet)
General	N/A	3	3
Scenario	N/A	4	4
Big Five	10	20 (2)	100 (10)
Schwartz	19	19 (1)	57 (3)
Dark Triad	3	9 (3)	27 (9)
Emphasizing-Systemizing	2	8 (4)	80 (40)
Total	*34*	*63*	*271*

For ten aspects of big five, I used the questionnaire developed by DeYoung *et al.* (2007) where each of the ten aspects is measured with ten questions. For the short version of the questionnaire, we included two first questions for each aspect.

For measuring Schwartz values, questions used by Schwartz *et al.* (2012) were used but they were changed so that they conform to the linguistically to other question (e.g. they were changed to 1. person). Each of the 19 facets was described by three questions. Each question was presented with a 5-step Likert scale as opposed original 6-step or 8-step used by Schwartz *et al.* (2012). For the short version of the questionnaire, we selected the first question from each of the 19 facets.

For the Dark Triad, I used the questions created by Jones and Paulhus (2014) using 5-step Likert-scale. The questionnaire uses nine questions for measuring each facet (Machiavellianism, narcissism, psychopathy) of Dark Triad. For the short version of the questionnaire, we selected three first questions from each of the three facets.

There are separate questionnaires developed to both Empathizing (Baron-Cohen & Wheelwright, 2004) and Systemizing (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003) with 60 questions for both measures. Both of the original questionnaires contain 20 dummy questions. Their idea was to make the purpose of the relevant questions less obvious (Baron-Cohen & Wheelwright, 2004; Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003). The dummy questions were dropped in this questionnaire leaving 40 relevant questions for both measure. Original questionnaires used 4-step likert scale with unorthodox scoring scheme (Baron-Cohen & Wheelwright, 2004; Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003). This was changed in this study so that 5-step Likert scale is used with normal scoring. For the short version of the questionnaire, I selected four first questions for each facet.

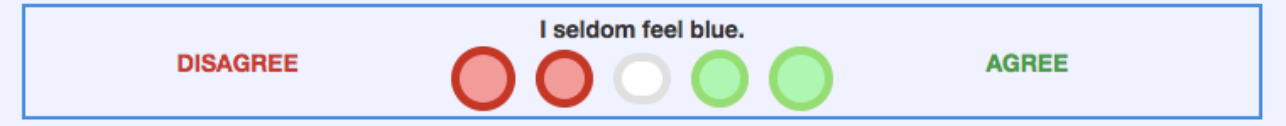
As mentioned above this study had multiple questionnaires in it. They were merged to a single questionnaire. Fitting questions from multiple questionnaires was in at itself difficult. Problems include different Likert-scales used (4-step, 5-step, 6-step or 11-step), different ways phrasing questions (first person, third person) and different ways phrasing extremes. This leaves us with two options which both have shortcomings: Either the full questionnaire consists of differently

formulated questions or all the questions are normalized to standardized form. We selected the latter approach based on the following considerations:

- (Positive) The full questionnaire is more usable and pleasing to use to the subjects. This is an important consideration, as psychometric questionnaires have well known problems of attracting subjects. This has led to unfortunate situation where most of the subjects for psychometric studies are 20-something university students studying psychology. [25] Acquiring subjects that way would probably be fatal to this study as we expect that people willing to travel to space are small minority and are not presented amongst university students. Moreover, we expect suboptimal design to contribute to the dropout rate of those who start filling the questionnaire, which already high at its base rate. [26] Therefore, we see it fit to pay heavy emphasis to usability as we expect it to contribute heavily to the probability of a random subject finishing questionnaire.
- (Positive) Technical implementation is more straightforward as all the questions require same amount of screen estate, have common headers, etc.
- (Positive) When all the questions are of same form, we can randomize the order over the full questionnaire by mixing questions from different questionnaires. If the original form of each questionnaire would be retained, we would be forced to present questionnaires one by one. We see this as a shortcoming as we hope to retain the option to build factor model from the ground up. Randomizing all the questions also protects us from a possible priming effect relating to the fact that questions of the same sort are asked in clumps. (Also, the different form of questions in each questionnaire ques the subject of different set of questions.)

- (Negative) Making changes to questions makes it more difficult to compare the results to norms gathered elsewhere. We try to minimize this problem by trying to retain the gist of each question as faithfully as possible.

Figure 1: An example question.



Based on the following considerations, all the questions are presented in 5-step Likert scale with leftmost option being "Disagree" and rightmost option being "Agree." In between options are not labelled but the scale is indicated with clear color and side coding of the options. All the questions are presented in first person. See Figure 1. Two of the questionnaires (for Empathizing and Systemizing) have filler questions (20 each) that are not supposed to measure anything. As the questionnaires were already really long and, as pointed above, attrition was a real worry, we removed filler questions. As mentioned above, the order of questions was randomized over all the questions. The randomization was done separately to long questionnaire and short questionnaire.

The specific changes to each questionnaire are summarized in Table 3.

Table 3: Specific changes to made original questionnaires. All questions were normalized to same form regarding the following features. Order *refers to order in which questions are presented. The order of the questions was randomized in all questions.* Likert scale *refers to scale used in the questions. The scale used in all questions was 5-step Likert scale.* Grammatical person *refers to whether the questions were asked in 1st person or 3rd person. In this questionnaire 1st person was used.* Scoring scheme *refers to method how answers are converted to numbers. In this study the typical (-2, -1, 0, 1, 2) scale was used.* Question formulation *refers*

to way the questions phrased to make the answer options sensible. This questionnaire used answer scale from "disagree" to "agree."

Questionnaire	Order	Likert scale	Grammatical person	Scoring scheme	Question formulation
Ten Aspects of Big Five (DeYoung *et al.*, 2008)	X				
Schwartz Values (Schwartz *et al.*, 2012)	X	X	X		X
Empathizing (Baron-Cohen & Wheelwright, 2004)	X	X		X	
Systemizing (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003)	X	X		X	
Dark Triad (Jones and Paulhus, 2014)	X				

The Cronbach's α's can be seen in Table 4 for each dimension.

Table 4: Cronbach's αs for BIG-5 dimensions.

Dimension	**Cronbach's α**	**Dimension**	**Cronbach's α**
Ten Aspect of Big Five		*Schwartz Values*	
Neuroticism	0.93	Self-direction	0.64
Volatility	0.91	Self-direction of Thought	0.60
Withdrawal	0.88	Self-direction of Action	0.56
Agreeableness	0.83	Stimulation	0.67
Compassion	0.87	Hedonism	0.71
Politeness	0.68	Achievement	0.67
Consciousness	0.85	Power	0.80
Industriousness	0.85	Power trough Dominance	0.77
Orderliness	0.82	Power trough Resources	0.69
Extroversion	0.88	Face	0.60
Assertiveness	0.89	Security	0.67
Enthusiasm	0.82	Personal Security	0.61
Openness to Experience	0.82	Societal Security	0.57
Intellect	0.85	Tradition	0.84
Openness	0.76	Conformity	0.73
		Conformity to Rules	0.72
Dark triad	0.78	Interpersonal Conformity	0.79
Narcissism	0.63	Humility	0.46
Psychopathy	0.61	Benevolence	0.78
Machiavellianism	0.74	Dependable Benevolence	0.69
		Caring Benevolence	0.77
Empathizing and Systemizing		Universalism	0.77
Systemizing	0.89	Universal Societal Concern	0.64
Empathizing	0.88	Universal Care for Nature	0.76
		Universal Tolerance of Differences	0.57

Analyzing the Relationship between Psychometric Dimensions and Willingness to Go

The relationship between the psychometric dimensions and willingness to go will be analyzed using simple regression model where each psychometric dimension is used to explain the willingness to go -variable. As there is 34 different psychometric dimensions to be tested, we use Bonferroni correction. Generally, each different analysis will use Bonferroni correction when applicable.

The potential second level mediation structure is analyzed using the Causal Mediation Analysis.

The whole model will be verified using structural equation model (SEM) analysis (Rosseel, *et al.*, 2017).

Results

Relationship between Single Psychometric Dimensions and Willingness to Go -Variable

Systemizing Cognitive Style Explains Willingness to Go

Of all the different psychometric dimensions, only the systemizing cognitive style explained willingness to go ($p < .001$, $t = 5.06$, $R^2 = .12$, corrected) when using simple single variable regression analysis. Of other psychometric dimensions the following personality features and values initially explained willingness to go: intellect (personality), industriousness (personality), stimulation (value), self-direction of thought (value), conformity to rules (value), universal tolerance of differences (value) and dependable benevolence (value). To verify the explanatory power of these variables, a model where each of them explained willingness to go with systemizing cognitive style was created. In each case, only systemizing cognitive style remained statically significant explaining feature.

Explaining Factors behind Systemizing Cognitive Style

It is concluded that the systemizing cognitive style is sole explaining variable for the willingness to go but the results indicate that there is underlying mediating structure behind different psychometric dimensions.

First, the relationship between systemizing cognitive style and aforementioned psychometric dimensions was analyzed by building a single variable regression model where one variable explains systemizing cognitive style. As there are 9 different models to consider Bonferroni correction was used. The following personality features and values explain systemizing cognitive

style: intellect (personality) ($p < .001$, $t = 8.53$, $R^2 = .28$), industriousness (personality) ($p < .001$, $t = 4.56$, $R^2 = .10$) stimulation (value) ($p < .001$, $t = 4.73$, $R^2 = .11$), and self-direction of thought(value) ($p < 0.001$, $t = 6.80$, $R^2 = .20$).

Table 5: Mediation models and their average causal mediation effects (ACME) and average direct effects (ADE). Low p-values in ACME indicates a mediation model and low p-values for ADE indicate direct effect.

Variable of interest	ACME p-value	ADE p-value
Intellect	$< .001$	$.58$
Industriousness	$< .001$	$.38$
Stimulation	$< .001$	$.19$
Self-direction of thought	$< .001$	$.89$

To verify the indicated underlying structure, the linear model for systemizing cognitive style was analyzed. The model parameters are in Table 5 where we can see that when all four variables are used (adjusted $R^2 = .33$). Only personality feature intellect remained significant. Nevertheless, other three variables were close enough the level of significance that a further study of the said features seems justified.

Table 6: Linear model explaining systemizing cognitive style.

Variable	*t* value	p-value
Intellect	4.79	$< .001$
Industriousness	1.85	$.065$
Stimulation	1.96	$.052$
Self-direction of thought	1.81	$.072$

To further explore the justification for other variables, self-direction of thought (value) was dropped from the model. The updated model parameters are in the Table 6. In this case, also industriousness (personality feature) and stimulation (value) become statically significant even though the p-values remain worryingly close to threshold value of $.05$.

Table 7: Linear model explaining systemizing cognitive style.

Variable	t value	p-value
Intellect	6.01	$< .001$
Industriousness	2.16	$.032$
Stimulation	2.96	$.035$

The potential second level mediation structure was analyzed using the Causal Mediation Analysis with the assumption that intellect has direct causal link to systemizing cognitive style and industriousness (personality feature), stimulation (value) and self-direction of thought (value) could affect systemizing cognitive style though intellect. (Imai, Keele & Tingley, 2010) All of them have both a direct effect to systemizing cognitive style and also affect it through affecting intellect.

Table 8: Mediation models explaining systemizing cognitive style and their average causal mediation effects (ACME) and average direct effects (ADE). Variables are systemizing cognitive style s, Intellect i, Industriousness c, Stimulation m and Self-direction of Thought t. Low p-values in ACME indicates a mediation model and low p-values for ADE indicate direct effect.

Variable of interest	Mediation model	ACME p-value	Direct model	ADE p-value
Industriousness	$\begin{cases} s \sim i \\ i \sim c \end{cases}$	$< .001$	$s \sim i + c$	$.082$
Stimulation	$\begin{cases} s \sim s \\ i \sim m \end{cases}$	$< .001$	$s \sim i + m$	$.008$
Self-direction of thought	$\begin{cases} s \sim i \\ i \sim t \end{cases}$	$< .001$	$s \sim i + t$	$.004$

The initial model, derived above, is significant but for the self-direction of thought which does not explain significantly neither systemizing, nor intellect (p-values were $.08$ and $.21$ correspondigly). When the model is updated accordingly by dropping the self-direction of thought, all the regression variables are significant. RMSEA is to be $< .001$, Comparative Fit Index (CFI) is 1.000 and Tucker-Lewis Index (TLI) is 1.002. The final model is visible in Figure 2.

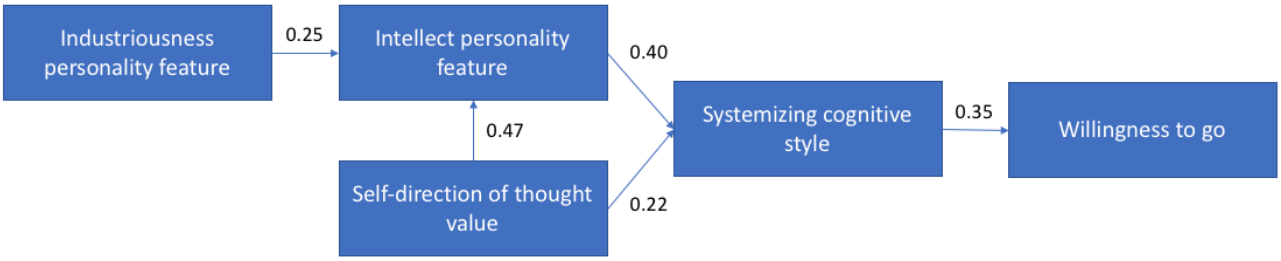


Figure 2: Structural model explaining the willingness to go. Numbers by the arrows are regression coefficients for the relevant regression model.

Comparison to Potentially Related Groups

This study and studies on other groups have five trait model of personality in common. Therefore, model for comparison between groups is used. Out of those traits, consciousness (our model has industriousness, which a subdimension of consciousness) and openness to new experiences (our model has intellect, which a subdimension of openness to new experiences) are found to correlate with willingness to go. This does not match any of the speculated groups of people one on one. Specifically, those willing to go to space differ from people joining military (lower agreeableness, lower neuroticism, lower openness to new experience), military aviation pilots (higher extroversion, lower agreeableness, higher openness to new experience for females), people willing to migrate (higher openness to experience, lower agreeableness) and people divorcing (lower agreeableness, higher neuroticism). Unexpectedly, astronaut applicants (lower neuroticism, higher openness to new experience, higher agreeableness, higher consciousness) are somewhat similar to those willing to go to space. Nevertheless, astronaut candidates have markedly low neuroticism and higher agreeableness, both which seem to be missing from people willing to travel to space.

Discussion

Systemizing Cognitive Style and Willingness to Go to Space

This study found clear evidence that there is a certain type of cognitive style is more prevalent amongst those whose are willing to travel to space. Namely this refers to the systemizing cognitive style, characterized by fluency and preference in using system centric cognitive style (Baron-Cohen, 2002; Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003; Ling, Burton, Salt, & Muncer, 2009). Of the psychometric variables measuring systemizing cognitive style, the individual questions "if there was a problem with the electrical wiring in my home, I'd be able to fix it myself," and "I am fascinated by how machines work," and "when I hear the weather forecast, I am not very interested in the meteorological patterns" (reverse) were the best predictors for willingness to go.

Structural Model

One psychometrically interesting finding was the underlying structural model (Figure 2) behind the systemizing cognitive style and the willingness to go. It is fascinating to note that both personality features and Schwartz's values are underlying predictors of systemizing cognitive style. Systemizing is predicted by intellect (personality) and self-direction of thought (value).

Intellect proper is one if the two facets of Openness to Experience and can be described with phrases like "quickness of thought", "creative", "interested in ideas", "having ingenuity", "competent" (DeYoung, Quilty, & Peterson, 2007). Self-direction of thought indicates that a person values autonomy of thought, leading him or her to use (and develop) his or her intellectual

competence and personal understanding of the world, and is associated with terms like “creativity”, “imagination”, “curious” and “interested” (Schwartz, *et al.*, 2012).

It is also interesting that within personality, industriousness explains intellect. Industriousness is one if the two facets of Conscientiousness and industrious people can be described with words “purposeful”, “efficient”, “self-disciplined”, “competent”, and “organized” (DeYoung, Quilty, & Peterson, 2007).

It is not clear if the underlying relationship between cognitive style, personality and values is a general feature of relevant traits for, or merely a structure that applies only within the subpopulation that participated in the study. This question is relevant as sample is not random and might not be representative of the general population. The sample was mainly collected from a discussion forum that attracts specific type of personalities. This is also clearly visible in the sex ratio of the sample which is 9:1 (see Table 1).

Interestingly, willingness to go is not primary predicted by classical constructs that predict person’s willingness to participate to novel experiences such as openness to new experience and the need for stimulation. The need for stimulation does not predict the willingness to go and only a subdimension of openness to new experience, intellect, is a predictor of a systemizing cognitive style and hence the willingness to go.

A New Research Field

This study demonstrated that existing research on the impacts of personality traits in various fields of life has not identified a comparable group of people. Potential similarities between astronauts, soldiers, pilots, and those willing to go through a major life event such as migrate or divorce was analyzed. Unsurprisingly, some similarities were found between those willing to go to space and

astronauts. Nevertheless, astronauts appeared to have additional qualities: they are very low on neuroticism and higher on agreeableness, which might be due to the selection process to enter the profession. Nevertheless, these findings give a clear message: voluntary travel to space is separate research topic that has not been previously researched.

As this is a pilot study, the findings should be replicated with additional rigor and a larger set of participants. These studies should also be extended to involve interviews and more detailed psychometrical evaluations including IQ. The interview should try to understand what kind of motivations, expectations, strengths and weaknesses each individual has. This would give us a better understanding who is really willing to go, whether there are couples or entire families willing to go, what kind of values such people have, and so on.

Habiting a remote location with an extremely hostile environment without any sensible contact to civilization offers set of psychological problems with different time spans. Firstly, any human presence in space must able to maintain itself for months and even years. This requires that the basic capabilities to work and function must be present, including the maintenance of mental health. Secondly, if permanent colonies are formed, people must be able to maintain functional society for year or decades. This means that they must form a functional culture that will control societal stability through the rule of law and social norms. This includes, for example, topics such as the role of religion, sexual norms, managing internal trade, and punishment of criminals. Finally, if we are to propagate as a species, the aforementioned culture must be transferred to next generation born in Mars. This means tackling questions concerning a longer time span of decades and centuries. Relevant questions include how children are schooled and raised, how is procreation managed, and what makes a culture viable, meaning the ability to maintain itself over multiple generations.

The above-mentioned long-term time spans should eventually be researched. The next step should be to set up simulation studies, where a group of people are tasked in surviving long period of time (such as half a year, two years, five years) in close quarters and extremely hostile environment. Important research questions include how people in such conditions should be supported, what kind of social structures they form, and how they manage the situation as individuals and as a group. One interesting question is the optimal size of these colonies, which primate studies indicate that may be somewhere between 100 to 230 persons. (Dunbar, 1992, 1993; Hernando, Villuendas, Vesperinas, Abad, & Plastino, 2010)

If the period of separation is long enough, we will probably see changes in people's values and even religiousness. It could be speculated that Martian colonies will be quite religious based on the harsh conditions described by rules with repressive sanctions, high religiousness where supreme value is attached to the direct interest of the society. (Norris & Inglehart, 2004; Demerath, 2001; Bonimi, 2003: Durkheim, 1984) Religion has helped small scale societies to grow to large scale societies. (Turchin, Currie, Turner, & Gavrilets, 2013; Purzycki, et al., 2016; Norenzayan, et al., 2014; Henrich, et al., 2010) It will probably also have a role in maintaining small scale societies.

In short, psychology of space colonization will be a real and important topic for future research.

Conclusion

This thesis identified psychological features behind those willing to travel to space and to other heavenly bodies: They are high on systemizing cognitive style. This study is first of its kind on the topic of the voluntary space travel. This topic is both relevant and offers numerous interesting future research directions.

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Appendix A: Measuring the Willingness to Go

First, I needed to establish what is, in fact, space travel. Current commercial sphere and public imagination has (at least) the four following different visions:

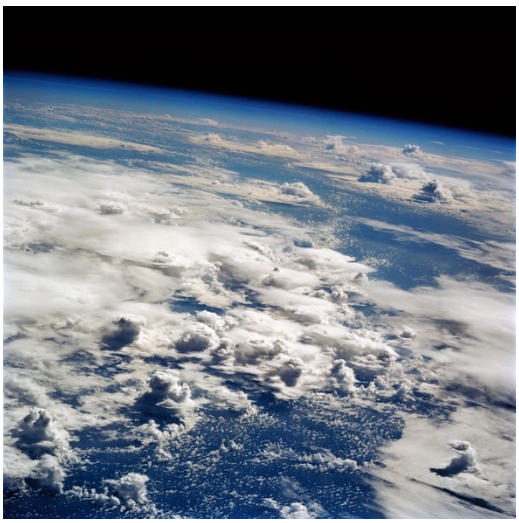
- Hotels for tourists in near earth orbit
- Asteroid mining
- Founding of a colony to Mars
- Initial, self-sacrificing, missions to establish first human presence at Moon or Mars

Based on each of these visions, I formulated a scenario describing in as vividly as possible.

Willingness to travel Earth orbit

The scenario is as follows (the image and bolding are from the original):

> *We live in a near future. Hotel Andromeda advertises extensively. It is the 'talk of the town'. It is one of the first **orbital hotels**. With the right price you get to travel to space and see the world as it looks from 500 km (300 miles) above the ground. The one week trip will include space walk and full accommodation.*



***The travel costs are large**. First, the trip would consume all your savings and you would also need to take a bank loan to finance your trip. It would be able to pay it back in three years. During that three years your living would be stripped from most of the little life luxuries. It is a trade-off. Your bank is willing to give you the loan.*

*Also, there are lingering **safety issues**. To go you need waive all your rights and it is understood that the technology is quite new. There was a fatal malfunction two years ago but after that the hotel has been running without problems. Some of your relatives are against you taking this risk.*

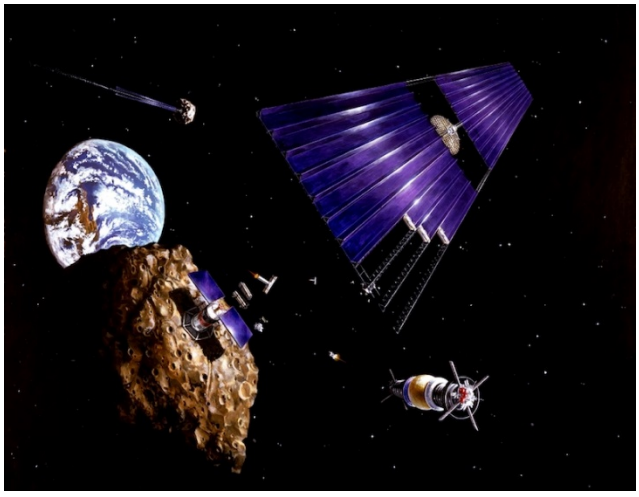
Would you take this opportunity to travel to orbital hotel?

If the subject selects Maybe, he or she is presented the following options to values that would indicate his or her willingness to travel:

- The really high **price** is something that I'm willing to tolerate. / The **price** needs to be lower, comparable to a typical summer holiday trip. (Bolding are from the original.)
- The unverified **safety** record is something that I\'m willing to tolerate. / The **safety** record of the operation has been verified so that the risks of travelling to space are comparable to flying an airplane. (Bolding are from the original.)

Willingness to work temporarily in lonely, hostile space environment

The scenario is as follows (the image and bolding are from the original):

> *Space Mining Inc. has been running a **space mining** operation for a decade. The company has set up mining facilities to certain asteroids. It is not yet profitable business. The demand for raw materials in space has not yet really kicked in. Basically the only customers are micro chip manufacturers who have small scale test operations. Nevertheless, mining operations are financed by investment and there many small start-up operations as markets genrally expect the whole micro prosessor industry to move to the space fabs in the coming decades as easy access to vacuum and gravity free environment offers great benefits to manufacturing processes.*
>
> 
>
> *Space Mining Inc. is offering a job at its mining stations. The job gig **takes a year** and is, in some ways, comparable to working at oil rigs. The **social environment** can be quite depressing. The work days are long and physically demanding. Some of your collegues have difficult personalities. Alcoholism is rampant. Your work colleagues are having regularly brain shattering hangovers and behave accordigly. They do their job and expect you to leave them alone.*

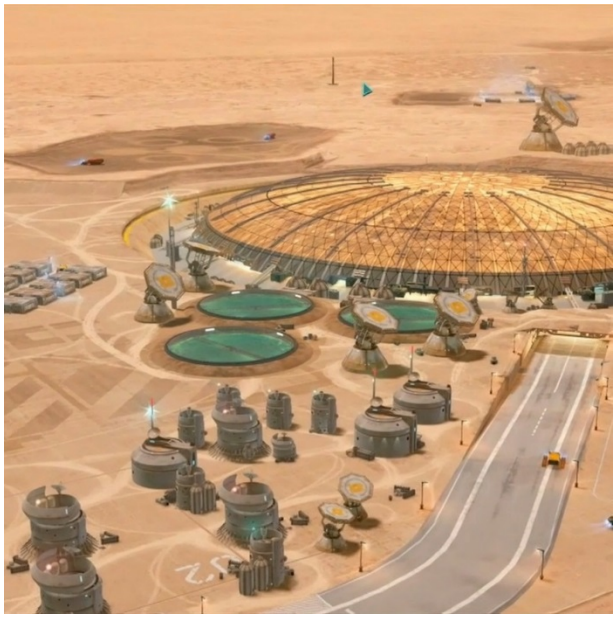
> *The operation is a unisex and **no family members** are not allowed. In addition data connections back to earth are sporadic at best.*
>
> *As the operation is not that profitable, the **salary** is comparable to what you are making here at earth.*
>
> *Also, after the return to the earth, **the recovery** to earths environment will take 3-6 months. This includes handing the gravity, etc.*
>
> *There are speculative **health risks**. Some believe that people that have worked on space mines are more prone to get cancer in coming years. The emerging industry has no resources, nor the inclination to research this.*
>
> *Would you take this opportunity to work in space?*

If the subject selects Maybe, he or she is presented the following options to values that would indicate his or her willingness to travel:

- I don't mind about the hostile **social environment** and will be able to perform in described environment. / **Social environment** needs to be welcoming with sensible attention paid to general mental wellbeing of the workforce. (Bolding and are from the original.)
- Unisex, **no families -policy**, is fine with me. / **No families -policy** is intolerable for me. We need to be able to travel there as a couple, or workplace romance needs to be tolerated. (Bolding are from the original.)
- **Money** is not an issue for me. I'm motivated by other things. / **The pay** needs to be really high so that I would be saving serious money compared to what I would make in earth. (Bolding are from the original.)
- I'm willing to take the associated **heath risks**. / The **health risks** of the mining gig needs to be minimal and comparable to, for example, to those of airplane pilots. (Bolding are from the original.)

Willingness to permanently move to foreign planet

The scenario is as follows (the image and bolding are from the original):

> *Humans have figured out how to make a living on the **surface of Mars**. Multiple separate colonies have formed. A typical colony habits a small dome that sustains life for approximately 240 persons.*
>
> 
>
> *You are offered a place in a dome called New Oslo founded 15 years ago. As almost all domes in Mars, it basically lies **outside any jurisdiction**. The dome is ruled by a commander that is elected for a 6-year term. The current ruler, John Milton, is known to be just but strict. The dome habitants like it that way and Milton is expected to be re-elected to his fourth term in three years' time. The commander has the powers to give death penalties.*
>
> *They have **strict moral norms** and rules for social interaction. Some speculate that it is necessity as even small cracks in the societal fabric. For example, cheating can be considered to be existential threat to whole dome. Cheating in relationship leads to jealousy. Jealousy leads to soured work environment and mistakes. And mistakes, like a failure in air conditioning, lead to extinction of the*

whole dome. Be that as it may, the moral norms are extremely strict and are enforced with vigour.

*The strict moral norms have led to strict control of moral thought and the habitants of the dome are **religious**. Religion is not discussed openly but everybody is expected to be at least observant to the religion and not make apostasy.*

*The typical weekday is **filled with work** and people typically work between 12-15 hours per day in a six-day workweek and have a seventh day for rest. There are also short religious holidays approximately every 100 days.*

*If you decide to take this opportunity, you **won't be able to leave**. You need to leave your current life behind. Some people signify this change by taking a new name when they arrive to the dome. They baptized to their new life and their new religion with a new name.*

Would you take this opportunity travel to Mars?

If the subject selects Maybe, he or she is presented the following options to values that would indicate his or her willingness to travel:

- The ad hoc, dictatorial **legal system** is tolerable to me. / I need to know that **rule of law** established here on earth is also observed in the colony. (Bolding and are from the original.)
- I'm willing to accept and observe the **religion** of the colony. / The conservative **religious** societal setting is unacceptable for me. (Bolding and are from the original.)
- The **strict moral norms** are something that I'm willing to accept (or embrace). / The society needs to tolerate differences in **personal morals**. Personal lives of individuals are no concern of others or the community in general. (Bolding and are from the original.)

- I'm willing to **work** long work weeks. / The amount of the **work** required by the society needs to be reasonable. (Bolding and are from the original.)
- **Leaving my current life** behind is acceptable price. / I need to have an option to select to **come back to earth**. (Bolding and are from the original.)

Willingness to sacrifice life for space exploration

The scenario is as follows (the image and bolding are from the original):

> *Humans are making **first steps in the colonization of Mars**. The first habitable environments are under constrution. Basically the first foundations for more permanent settling of the planet are being laid. You are offered a position in the colonization procect. You are asked to **travel to surface of Mars**.*
>
> 
>
> *You would need accept that you live there for the **rest of your life**. The space travel is as such point here that no possibility for return can't be guaranteed and it is not even planned.*
>
> *The radiation and otherwise hostile enviroment is tolling. Doctors estimate that you be able to stay **alive 3-5 years** after which you would be considered terminally ill. The travel arrangements are open about this and assisted suicide is both dicussed and planned.*

> *You would be **alone** at your own station. You could be in contact with other stations but visitations between stations are not yet expected. You would still have human interaction as you would be offered data link to other stations and back to earth.*
>
> *Are you willing to become a hero of space exploration and sacrifice your life for it?*

If the subject selects Maybe, he or she is presented the following options to values that would indicate his or her willingness to travel:

- I'm willing to go to Mars without option of **coming back**. / I need to have an option to **come back** to earth eventually. (Bolding and are from the original.)
- The shortening of **life span** is acceptable. / I need to have possilibility for a **longer life**. (Bolding and are from the original.)
- I'm willing to spend the whole time **alone**. / Social interaction is a requirement for me. I can't be **alone** all the time. (Bolding and are from the original.)

Appendix B: Internet discussion

The general public had an opportunity to spell out their ideas and interests in popular discussion board called Slashdot. (“Ask Slashdot,” 2017) We managed to get the following post posted to the front page of the Slashdot:

> ***Ask Slashdot: What Kind of Societies Will the First Mars Colonies Be?***
>
> *New submitter nyri writes:*
>
> > *I'm making a two-part study in what kind of societies humans will build on Mars when we start to colonize the red planet. In first part, I'm trying to approach the question sociologically as rigorously as possible. Sociology being what it is, this also includes informed speculation. So, what does Slashdot think: What sort of colonies will humans build on the red planet? How large will they be? How will they make decisions and select their leaders? What kind of judicial systems will they use? What happens if a colony's population grows larger than they are able to sustain? Will they be religious and if so, how? How will their internal and external economy work? And so on...*
> >
> > *A second part of the study is of psychometric nature to explore the kind of personalities be present in first colonies. I also encourage you to take the survey [Link to the survey].*

The discussion attracted 305 comments in total (5 comments from the author and 300 comments from general public). This discussion was the main source of answers to the questionnaire.

Appendix C: Single Questions

As a separate analysis, I analyze the relationship between the willingness to go and each separate question, using simple regression analysis. It turns out there are a set of questions that alone are quite strong predictors of wiliness to go. See Table 9. Based on these questions, we can start to formulate a description of future space travelers. The single questions results support the findings of the main analysis as can be seen in Table 9: The dimensions present in structural model are most prominent questions correlating with willingness to go. In addition, a few questions pop put from empathizing cognitive style and withdrawal personality feature. The questions indicate that empathizing might have an internal structure where certain kind of bluntness or honesty could be a factor explaining willingness to go. Finally, from withdrawal not being easily afraid correlates with willingness to go. These findings are mainly about empathizing and withdrawal and do not conflict with the main analysis.

Table 9: Statistically most significant questions predicting the willingness to travel to space. P-values are Bonferroni corrected as we calculated 264 correlations. Statistically significant p-values are bolded. Questions that are statistically not significant but still are potentially significant are included in to identity a potential qualitative trend in questions.

Dimension	Question	$\|t\|$	Coef.	Corr. p
Empathizing	If anyone asked me if I liked their haircut, I would reply truthfully, even if I didn't like it.	5.55	0.36	$<.\mathbf{001}$
Systemizing	If there was a problem with the electrical wiring in my home, I'd be able to fix it myself.	4.81	0.26	$<.\mathbf{001}$
Systemizing	I am fascinated by how machines work.	4.74	0.36	$.\mathbf{001}$
Withdrawal	I'm afraid of many things.	4.66	-0.27	$.\mathbf{002}$
Systemizing	When I hear the weather forecast, I am not very interested in the meteorological patterns.	4.60	-0.30	$.\mathbf{002}$
Industriousness	I get things done quickly.	4.08	0.28	$.\mathbf{018}$
Intellect	I like to solve complex problems.	3.79	0.33	$.053$
Industriousness	I find it difficult to get down to work.	3.65	-0.22	$.092$
Systemizing	I am not interested in understanding how wireless communication works.	3.60	-0.24	$.11$
Systemizing	When travelling by train, I often wonder exactly how the rail networks are coordinated.	3.58	0.21	$.12$
Empathizing	I am able to make decisions without being influenced by people's feelings.	3.55	0.26	$.13$
Systemizing	When I am walking in the country, I am curious about how the various kinds of trees differ.	3.52	0.22	$.15$
Systemizing	When I talk to people, I tend to talk about their experiences rather than my own.	3.48	0.23	$.16$
Systemizing	If I were buying a stereo, I would want to know about its precise technical features.	3.46	0.22	$.18$

The specific questions also regarding systemizing cognitive style can be compared to factor model proposed by Ling, *et al.* (2009) with four potential facets: "An interest or ability with DIY," "interest or ability with technical information," "interest or ability with the structure of things" and "interest or ability with spatial arrangements." The questions in Table 9 didn't correspond with any single of these four facets, as out of the nine questions relating to systemizing cognitive style only four were mentioned by Ling, *et al.* (2009) (they dropped 22 questions because they didn't load to any of their factors). The four questions represented three of the four factor of Ling, *et al.* (2009). The model of Ling, *et al.* (2009) is not viable for this study.

The three questions that are measuring psychological features that are not present in model, warrant further research. The first question is “If anyone asked me if I liked their haircut, I would reply truthfully, even if I didn’t like it” and it nominally measures empathizing cognitive style. Never the less, it correlates more strongly with systemizing cognitive style ($p < .001$, $t = -5.27$, $R^2 = .13$) than with empathizing cognitive style ($p < .001$, $t = 3.91$, $R^2 = .08$). Second similar question “I am able to make decisions without being influenced by people’s feelings” also correlates more strongly with systemizing cognitive style ($p < .001$, $t = -5.97$, $R^2 = .16$) than with empathizing cognitive style ($p < .018$, $t = 2.39$, $R^2 = .03$). The third question “I'm afraid of many things” seems to represent its nominal withdrawal well.

Of the 14 most predictive question (out of which 6 were statistically significant in predicting and the rest where not random correlation at least with 80% probability), 8 were for systemizing, 3 were for other psychological features present in model and 3 were for other psychological features. Out of the latter three, two were nominally for empathizing cognitive style but in reality, they measured systemizing cognitive style better. The third question “I'm afraid of many things” measured withdrawal. This points to a direction that the lack withdrawal might be also an explaining factor for willingness to go but was not identified for the small sample size.